

TEN YEARS AFTER THE RADIOLOGICAL ACCIDENT OF GOIÂNIA, A REFLECTION



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Abstract

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This work contains a reflection on the impact of the radiological protection measures taken in the city of Goiânia in the aftermath of the accident involving caesium-137, along with a discussion on the biological foundation of these actions.

1. INTRODUCTION

In October 1987, the people of the city of Goiânia were surprised to hear from news reports that they were involved in a radiological accident. A group of twenty persons were already presenting symptoms associated with exposure to high doses of radiation and the clinical evolution of some of them led to the prognosis of death within a few weeks [1].

The Brazilian Nuclear Energy Commission (CNEN) sent out technical personnel specialized in radiological monitoring who, in view of the situation, requested that the Olympic Stadium be made available to them. There, the CNEN radiological team focused on identifying contaminated persons and decontaminating them by removing their contaminated personal effects and bathing them.

In Rio de Janeiro, where CNEN has its headquarters, the authorities strove to establish the strategy to be adopted in the face of the extension of the accident, which was already being observed. The technical staff were mobilized from the Institute of Energetic and Nuclear Research, the Centre of Development of Nuclear Technology, the Institute of Radiological Protection and Dosimetry, the Furnas Power Plants and the Brazilian Nuclear Industries. The Marcilio Dias Naval Hospital, in Rio de Janeiro, was set up so that it could receive some of the victims who had been exposed to high doses during the radiological accident, while the other victims were sent to the General Hospital in Goiânia.

The transfer of the injured from Goiânia to Rio de Janeiro may well be compared with a real war operation, since each individual represented a source of radiation and of potential contamination to anyone in the proximate vicinity.

At the time, magazines and newspapers published photographs of the technical staff wearing special clothing, masks and using equipment which distinguished them from the rest of the public. Aside from the hospitalized victims who, in fact, were seen as a confirmation that something very unusual had occurred, the gravity and the extension of the accident were conveyed to the public by the diagnosis of the technical staff, which had been mobilized for the occasion.

Whole areas of the city were isolated and interdicted, hundreds of inhabitants were removed from their homes, in many cases leaving all their belongings behind them. While people were submitted to decontaminating procedures, the population of the city was beginning to be discriminated against in other parts of the country.

2. PUBLIC PERCEPTION

For the average person caught in the whirl of these events, nothing except the declarations of the technical staff indicated that the city was in the midst of a radiological accident: no explosion, peculiar smell, tremor, climatic alteration, flood, fire nor any other phenomenon had been experienced that could be associated with an accident of such proportions, that it mobilized not only the technical, scientific and political authorities of Brazil, but also technical and scientific authorities at the international level, on top of the local and international media. This type of situation lends itself particularly to the development of stress, insecurity, panic and psychosomatic disorders, nowadays considered the main consequences of a radiological/nuclear accident. All of these afflictions were extensively diagnosed in the population of Goiânia [2] as well as in people not directly affected by the accident — those who started to discriminate against the inhabitants of the affected city.

3. TECHNICAL ASPECTS

The aim of all this mobilization was to avoid that other persons, beyond those who already presented symptoms of high exposure, became the victims of the delayed effects of radiation [3, 4]. In fact, according to the recommendations of the International Commission on Radiological Protection (ICRP), there is a risk of developing retarded effects, i.e. cancer [5, 6], associated with the slightest increase in radiation dose (since there seems to be a consensus that hereditary effects, so clearly characterized in animals, are not detected in the human species [4]).

Once the radioactive source had been removed, the medical procedures to be followed for cases of high exposure were established and the decontamination procedures were set for individuals and areas. While proceeding to decontaminate the main foci of contamination, CNEN started to look, through radiometric surveys and the use of cytogenetic dosimetry, for individuals who, though they did not present any symptoms of the dose absorbed during the evolution of the accident, had become potential victims, as they had contracted an increased natural risk of developing cancer when compared with a non-irradiated population, according to the ICRP. The group of persons identified would receive special medical attention in the light of this increased probability.

Technically speaking, the group selected through radiometric surveys and the use of cytogenetic dosimetry would be exposed to the stochastic effects of ionizing radiation [7], even if clinically they did not present anything that could be identified as a biological effect of radiation, except, in some cases, diseases of emotional order. The stochastic nature of these biological effects are because it is impossible to foresee, a priori, which individuals, in an exposed population, will develop cancer and a posteriori, who are the persons, in a group of people affected by the disease, whose cancer may be attributed to radiation.

Excluding from this analysis the individuals who actually developed immediate effects due to the accident, the other victims were identified either through radiometric surveys or through cytogenetic dosimetry, which is based upon the presence of chromosomal alterations introduced by radiation in lymphocytes of irradiated people. The correlation between the absorbed dose (estimated through cytogenetic dosimetry) and the risk of developing radiation induced cancer is established on the basis of the acceptance of the hypothetical existence of a linear relation, without threshold, between the absorbed dose and the risk of a stochastic effect, according to the ICRP.

If the hypotheses of linearity between dose and effect and of the absence of a threshold are accepted, the procedure for an accident will be to establish limits for exemption of areas, based upon a cost-benefit analysis, considering the cost of an operation of decontamination and the impact of this operation on the reduction of the dose of the affected population. In a certain way, this fact dismisses the hypothesis of the absence of a threshold dose limit: if the benefit of an operation does not justify its cost, it shall not be undertaken and the doses possibly resulting from the subsequent occupation of the exempted area shall not be considered any longer.

This approach may cause preoccupation among people involved in an accident comparable to that of Goiânia, insomuch as it becomes evident that, behind all the technical formalism displayed in an intervention of the scope of that conducted in this city, there is a determination to carry out the task in the best possible way, bearing in mind the basic directives of radiological protection. Nonetheless, the question remains: is this enough?

4. REFLECTION

If the recommendations of the ICRP are to be taken literally, a decontamination procedure will never be sufficient, since it assumes “the slightest increase in the dose ...”, and that the population cannot be asked to accept a risk, especially when the risk is not associated with any benefit.

However, such a view can be challenged if one analyses the premises on which the recommendations of the ICRP were established. Some fifty years ago, scholars observed the immediate effects of radiation in occupationally exposed professionals (including researchers and physicians) and the increase of cancers in the irradiated populations of Hiroshima and Nagasaki (stochastic effects). Since no data was available to evaluate the effect of this radiation in low doses (below 200 mSv) the ICRP, acting clearly out of a sense of caution, assumed that the effects of radiation at low doses were the same as those observed at high doses, and that the relationship between the dose and these effects was linear. This is the way the relation upon which the ICRP still bases itself to recommend actions of radiological protection was established. Nonetheless, in a number of particular conditions such as accidents, these actions cause some insecurity as to the measures to be taken, since the individual dose limit — which constitutes one of the pillars of radiological protection — can only be respected at a cost which does not correspond to the benefits that may be obtained.

5. OUTLOOK

In the past few years, several researchers have achieved results indicating the existence of a threshold dose in the development of biological effects [7–9], as well as the occurrence of beneficial effects resulting from these exposures [10–14]. The preoccupation of part of the scientific community with respect to the static position of the ICRP in this regard [15] is strong evidence that a general rethinking of this notion and practice, which are based on fears, misunderstandings and precautions, is about to take place formally. As a result, in situations similar to that faced by the city of Goiânia, radiological protection authorities will be able to carry out interventions based no longer on caution, but on scientifically developed concepts. Under these conditions, the population will no longer be exposed to fear and panic, but will receive solid scientific information which will be sure to cause less anxiety than that brought on by the recommendations of the ICRP.

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